CLAIMS:

1. A formatter for inscription of marks on to a 3D translucent optical medium to enable recording and retrieval of information from the medium, the formatter comprising:

a clamping mechanism to hold the media,

at least one optical unit calibrated to focus at least one diffraction limited spot within the medium at a respective depth therein,

at least one light source optimized for the inscription of marks, and

at least one actuator for moving said at least one spot relative to the medium.

2. The formatter according to claim 1, further including a controller for controlling fluctuations in ambient conditions in order to attenuate formatting variations caused thereby.

3. The formatter according to claim 1 or 2, wherein the medium is disc shaped and the motion of the spot relative to the medium is via rotation of the disc and motion of the one optical unit.

4. The formatter according to any one of claims 1 to 3, wherein the optical unit includes a beam splitting mechanism for splitting the beam whereby a plurality of marks are inscribed simultaneously.

5. The formatter according to claim 1, wherein the optical unit is an assembly including a plurality of component accurately calibrated optical units each being focused at a different depth and the assembly is adapted to move relative to the media so as to inscribe a multitude of tracks simultaneously.

6. The formatter according to any one of claims 1 to 5, further including a clamping unit for holding a stack of disks in precise mutual spatial disposition, to be accessed by a multitude of optical units and actuated by a multitude of actuators.

7. A formatted 3D translucent optical medium having a formatting pattern that is generated by a formatter according to any one of claims 1 to 6.

8. The formatted optical medium according to claim 7, wherein the formatting pattern includes registration marks of controlled size and length for enabling data to be written to or read from a desired location in the optical medium.

9. The formatted optical medium according to claim 7 or 8, wherein the registration marks are arranged in base layers having a known mutual separation.

10. The formatted optical medium according to claim 9, being a disc having two sides and a thickness of 6 mm, wherein:

the base layer separation is 160 micron;

an intermediate volume free of data having a depth of 80 micron; and

there is a minimal distance between a base layer and a surface of the disc of 200 micron.

11. The formatted optical medium according to any one of claims 7 to 10, wherein the registration marks are servo marks that are radially or axially offset or angularly tilted relative to an axis of the data track.

12. The formatted optical medium according to any one of claims 7 to 11, wherein a plurality of discrete servo offsets in 3D or a continuous range of servo offsets in 3D, are used to obtain a 3D tracking error signal.

13. The formatted optical medium according to any one of claims 7 to 12, wherein the servo offsets are respective spatial offset magnitudes from a nominal track center or different respective angular tilts relative to a nominal track axis.

14. The formatted optical medium according to any one of claims 7 to 12, wherein the formatting pattern comprises intervals along each data track, each of said intervals having a respective type that indicates a property of the data associated with the interval.

15. The formatted optical medium according to any one of claims 7 to 12, wherein the formatting pattern comprises a continuous servo pattern offset to the track allowing continuous recording of data.

16. The formatted optical medium according to any one of claims 7 to 15, wherein the formatting pattern comprises zoned spirals or circles in which sectors and headers are encoded.

17. The formatted optical medium according to any one of claims 7 to 16, being a one or two sided disk.

18. The formatted optical medium according to any one of claims 7 to 17, having an arrangement of alternating servo marks that define tracks in adjacent virtual layers such that the servo marks arrangement is equivalent to a triplet or a quadruple of servo indicators and such that the count of indicators is equal to the number of tracks intervals.

19. A tracking and formatting system for tracking data stored in the 3D formatted optical medium according to any of claims 7 to 18, said tracking and formatting system comprising:

a tracking unit for generating a tracking signal that conforms to the formatting pattern in said 3D formatted optical medium to enable calculation of a tracking error signal that is used as feedback for servomechanisms that control the precise location of a read spot according to said formatting pattern; and

a non-position sensitive detection unit coupled to the tracking unit and being responsive to the tracking signal generated thereby for reading data signals stored in data layers of said optical medium independent of a spatial structure of the detection unit.

20. The tracking and formatting system according to claim 19, wherein :

the formatting pattern includes registration and/or servo marks arranged in base layers having a known mutual separation for enabling data to be written to or read from a desired location in the optical medium; and

the tracking and formatting system further comprises an optical unit adapted to focus at least two laser beams of possibly mutually different wavelengths at respective points in the optical medium having a controlled mutual displacement, so as to form a read spot that is used to obtain a read signal from the optical medium and a write spot that is used for recording marks in the optical medium;

said tracking unit being responsive to the read spot for tracking an information track in a layer that is at least partially recorded and/or servo marked so as to allow the write spot to record data in an adjacent layer of the optical medium.

21. The tracking and formatting system according to claim 20, wherein the base layers include test areas to validate that there is no over-writing of the base layers.

22. The tracking and formatting system according to claim 19, wherein:

all data layers are pre-formatted at high accuracy and include a plurality of servo modulation marks disposed along opposite sides of each data track so as to be radially, axially or angularly offset relative to an axis of the data track; and

an optical unit is adapted to focus two laser beams of possibly mutually different wavelengths at respective points in the optical medium having a controlled small offset, so as to form a read spot that is used to obtain a read signal from the optical medium and a write spot that is used for recording marks in the optical medium.

23. The tracking and formatting system according to claim 21 or 22, wherein the servo marks are arranged in a plurality of discrete offsets or a continuous range of radial, axial or angular offsets.

24. The tracking and formatting system according to claim 21 or 23, wherein servo marks and the data marks are of different sizes and lengths.

25. The tracking and formatting system according to any one of claims 19 to 24, wherein any variations in the fixed offset between the read and write spots is corrected by tracking error signals of the form:

$$\frac{(A \cdot S1 - S2) - B}{D \cdot (E \cdot S1 + S2)}$$

where:

S1 and S2 are the respective signal amplitudes from the two offset mark sequences;

A and B are symmetry breaking factors; and

$D \cdot (E \cdot S1 + S2)$ is a general normalization factor.

26. The method according to any one of claims 19 to 24, wherein two pairs of servo offset marks are used in each axis to obtain the servo indication.

27. The tracking and formatting system according to claim 26, wherein the servo offsets include servo offsets of two different magnitudes and any variations in the fixed offset between the read and write spots is corrected by a track error signal of the form:

$$\frac{A \cdot (B \cdot S1 - S2) + C \cdot (D \cdot S3 - S4)}{I \cdot \left(E \cdot (S1 + F \cdot S2) + G(S1 + H \cdot S2)\right)}$$

where:

S1, S2, S3 and S4 are the respective signal amplitudes of the four offset mark sequences;

A, B, C and D are symmetry breaking factors; and

$I \cdot \left(E \cdot (S1 + F \cdot S2) + G(S1 + H \cdot S2)\right)$ is a general normalization factor.

28. The tracking and formatting system according to any one of claims 19 to 24, wherein:

the formatting pattern comprises a multitude of intervals along each data track, each of said intervals having a respective type that indicates a property of the data associated with the interval.

29. The tracking and formatting system according to claim 28, wherein said intervals include two types relating respectively to user data and to servo and system information.

30. The tracking and formatting system according to claim 28, wherein said intervals include two types of intervals having respective zoned constant linear lengths a first being dedicated mostly to user data and a second being dedicated mostly to servo and system information.

31. The tracking and formatting system according to claim 28, wherein said intervals include two types of intervals having respective zoned constant angular lengths a first being dedicated mostly to user data and a second being dedicated mostly to servo and system information.

32. The tracking and formatting system according to any one of claims 29 to 31, wherein the intervals have a pseudo-random variation of length.

33. The tracking and formatting system according to any one of claims 19 to 32, wherein the formatting pattern comprises zoned spirals or circles in which sectors and headers are encoded.

34. The tracking and formatting system according to any one of claims 19 to 33, having an arrangement of alternating servo marks that define tracks in adjacent virtual layers such that the servo marks arrangement is equivalent to a triplet or a quadruple of servo indicators and such that the count of indicators is equal to the number of tracks intervals.

35. The tracking and formatting system according to any one of claims 19 to 34, wherein the formatting pattern encodes auxiliary information in addition to nominal track center.

36. The tracking and formatting system according to any one of claims 19 to 35, being adapted for recording content.

37. A method for correcting spherical aberration in an optical system having a plurality of focusing elements, said method including disposing a correction element comprising an optical element that is common to a number of said focusing elements and having a major dimension that is larger than a respective major dimension of any of the

focusing elements and whose target of focusing to diffraction limit is separated into a first part that is mostly spherical aberration correction and a second part that is mostly focusing and the correction of other aberrations.

38. The method according to claim 37, wherein the correction element comprises two glass surfaces separated by a layer of optical oil, further including controlling a thickness of the correction element by actuating the glasses and pressurizing the oil.

39. The method according to claim 37, wherein the correction element comprises a pair of optical elements having nominally parallel surfaces, further including reducing aberrations by tilting of the parallel surfaces.